

HRDLICKA (Ales)

STUDY OF THE NORMAL TIBIA.

[Abstract]

(presented)
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STUDY OF THE NORMAL TIBIA.

[Abstract.]

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Observations and measurements were made on about 2,600 tibiae, almost 2,000 of which were bones of whites, 80 the bones of negroes, and the remainder the bones of North and Central American Indians.

The study of the bones of whites and negroes was carried on at the College of Physicians and Surgeons, New York, on the collection of Prof. George S. Huntington; the Indian tibiae were principally studied at the American Museum of Natural History, New York, and partly at the National Museum, Washington, and at the Peabody Museum, Boston.

The objects of the study are: 1. Contribution to the knowledge of variations of the bones; 2. Study of correspondence of different variations of the various parts of the skeleton; 3. The tracing, so far as possible, of the causation and tendencies of variations found; 4. The establishing of some standards, if possible, for comparisons.

The study presents numerous difficulties, the principal of which is due to a deficiency of data about many of the bones. This difficulty has been largely foreseen and diminished in Prof. Huntington's collection by a system of keeping records about the bones. A good system of records and provision for a proper identification of every individual specimen is, in the author's opinion, the main requisite and the most valuable feature of every large osteological collection. (A simple scheme for such identification and record keeping will be given in the detailed publication.)

Of the results of the study, in the main, only generalities are mentioned, the details, particularly those of the measurements, being left for print; the results are as follows:

The tibia differs much in shape, but the innumerable little variations can be arranged in a number of distinct *types*. The principal, though not the only differences in the bone, occur in the shape of the shaft. They are best appreciated when we study the shaft in a transverse section, particularly at the

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middle of the bone. The lower third of the shaft of the tibia is not so well differentiated as the middle, while the shape of the upper third is, in over a half of the cases, more or less disturbed by the oblique ridge.

There are six main types of the shape of the shaft at the middle of the tibia and one or another of these types was clearly recognizable in fifty-five per cent. of the bones of the whites, the remaining forty-five per cent. of the bones showing intermediary stages. In the majority of cases tibiae do not fully develop their type until after the complete union of their epiphyses. Negro bones show variety which may be due to some extent to admixture. Indian tibiae are much more homogeneous in their shape than either those of whites or of negroes, particularly the former. No marked difference was found in the shape of the tibiae of whites of different nationalities.

The six types of the shape of the shaft of the tibia at the middle are as follows: 1. Closely approaching a right equilateral triangle, found in 18.2 per cent. of white tibiae. 2. Closely approaching a lateral triangle, the posterior surface not facing directly backward, as in the previous type, but backward and outward, found in 14.9 per cent. of white tibiae. 3. Shaft more or less triangular with the external surface markedly concave, in 9.1 per cent. of the tibiae of whites, very prevalent among Indians, almost absent among negroes. 4. Shaft quadrilateral, posterior surface being divided by a marked vertical ridge into two lateral surfaces, in 5.1 per cent. of whites, mainly in males. This shape is somewhat less frequent in negroes, but considerably more frequent in Indians. 5. Posterior border blunt or effaced, posterior half of the shaft oval, in 5.2 per cent. of whites, mainly in females. 6. Internal surface flat or slightly convex, external and posterior surfaces quite convex, external border may be effaced; almost absent in whites, never met with in Indians, frequent in negroes (10.9 per cent.). Transverse sections of this type are very similar to those of the tibia of the gorilla. A little over five per cent. of all the white bones examined showed these various types in a perfect form (demonstration of whole bones and of sections).

The signification of the various shapes is obscure, but the author will follow a large number of the individuals to whom the bones belonged, and try to learn their vocation to see whether possibly this may not have had some effect in favor-

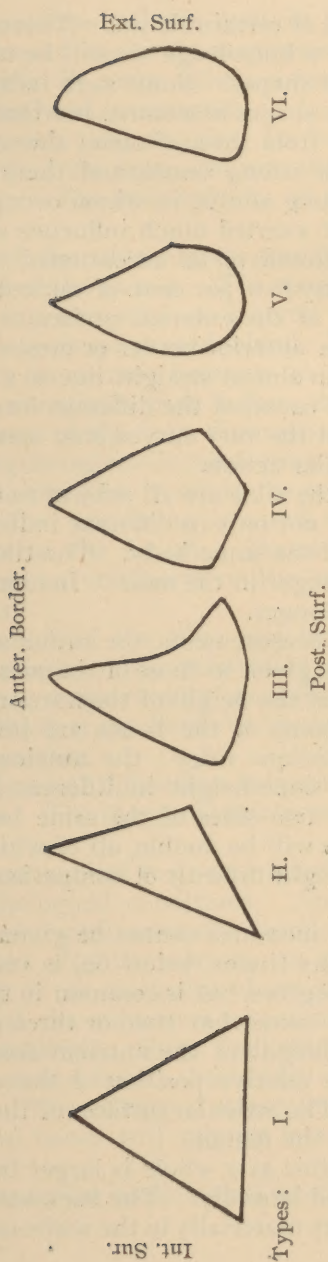


Illustration of the six types of the shape of the shaft of the Tibia. (Partly schematic.)

ing the development of certain shapes. There are indications that even with such a knowledge we will be much at a loss to explain the different shapes. Some such indications are the occurrence of all the shapes in women, and that in proportions not differing greatly from those of men; the weak bones differ quite as much as the strong bones, and there are found fully evolved types in young adults, in whom occupation or habits of life have not yet exerted much influence on the skeleton. The third type is found to be accentuated in some curved bones, but over thirty-five per cent. of curved bones did not show any concavity of the external surface to speak of.

The shape of the anterior border or crest of the tibia was found to vary from an almost straight line to a marked double curved figure. The causes of the different forms could not be definitely traced, but the very curved crest seems to be at least partly due to muscular action.

The *measures* of the tibia are all subject to numerous variations, and they differ not only in different individuals, but also in the two bones of the same body. The tibia is in average both longer and stronger in the male. In numerous instances the left tibia is the longer.

As to diametrical measurements, the author advocates that a preference be always given to those of the measured middle of the tibia over those at the height of the nutrient foramen. At this latter height many of the bones are influenced by the overgrowth of the oblique ridge; the nutrient foramina are not situated at the same height in different bones, nor even in the bones of the two sides of the same body; and occasionally the foramen will be double, all of which makes measures taken at this height difficult of comparison and not fully reliable.

The details of the measures cannot be given in an abstract. Advanced platycnemy (index below 60) is very rare in both the whites and the negroes, but is common in the Indians. In average the tibia is somewhat (two or three per cent.) more platycnemic at the height of the nutrient foramen than it is at the middle. The relative position of the external border can be measured. The articular surfaces of the male tibia are larger than those of the female.

The head of the tibia as a whole is larger in the male both antero-posteriorly and laterally. The backward inclination of the head does not vary materially in the whites and the negroes,

although in about one-half per cent. in the white bones the inclination backward is plainly augmented. In Mexican Indians, particularly in some tribes, a pronounced backward inclination of the head is common.

The spine is, as a rule, double. Its length is not dependent on the length of the bone, and may differ on the two sides of the same body. The male spine is, on the average, slightly longer.

The weight of the tibia differs greatly; it is much influenced by the age of the person. The weight and displacement of the bone being compared on a series of subjects, the following results in general were obtained: The tibia is heaviest in proportion to its volume between 20 and 40 years of age. Above 40, and sometimes even before, the weight in proportion to the volume of the bone diminishes. This diminution is due to the beginning senile rarefaction; it differs very much in different subjects, and is rarely the same on the two sides of the body. The rarefaction is much more regular and at all ages greater in the female. Bones of aged individuals may show as low as one-fourth of the relative weight found in young adults.

The displacement of the tibia may be measured with shot or seeds, by a rough and unsatisfactory calculation from the various measures, or by rapidly immersing the bone in some heavy liquid which is not liable to be rapidly absorbed. The author used glycerine.

There are chemical differences between the bones of young and old persons. The inorganic matter seems to decrease with age.

The tibia is not subject to gross anomalies, but is very much subject to pathological conditions. An interesting, though perhaps not congenital, anomaly found, consisted of a well-defined, rounded, slightly convex, six mm. broad, articular facet on the tip of the malleolus of one tibia.

The causes of the numerous variations of the tibia are apparently very multiple. Some indications point to the fact that they are partly due to hereditary influences and partly to acquisition. The effects of muscular action on the shape and size of the bones will require much additional investigation.

The details as to the pathological conditions found will also be given later.

DR. LAMB agreed with the author in at least two points; first, that platycnemism is common in the bones of Indians in the Army Medical Museum and not in those of negroes; and, second, that for the reasons given by the author, the tibial index is more reliably measured below the opening of the nutrient foramen and oblique ridge.

